What is claimed is:

1. A high strength and high toughness magnesium alloy containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3):

(1) $0.2 \leqq a \leqq 5.0$;

(2) $0.2 \leqq b \leqq 5.0$; and

(3) $0.5a-0.5 \leqq b$.

2. A high strength and high toughness magnesium alloy containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3):

(1) $0.2 \leqq a \leqq 3.0$;

(2) $0.2 \leqq b \leqq 5.0$; and

(3) $2a-3 \leqq b$.

3. A high strength and high toughness magnesium alloy according to claim 1 or claim 2 comprises a magnesium alloy casting product to which a plastic working is subjected.

4. A high strength and high toughness magnesium alloy

comprising a plastically worked product which is produced by preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3), and subjecting said magnesium alloy casting product to a plastic working, wherein said plastically worked product has a hcp structured magnesium phase and a long period stacking ordered structure phase at room temperature:

(1) $0.2 \leqq a \leqq 5.0$;

(2) $0.2 \leqq b \leqq 5.0$; and

(3) $0.5a - 0.5 \leqq b$.

5. A high strength and high toughness magnesium alloy comprising a plastically worked product which is produced by preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3), and subjecting said magnesium alloy casting product to a plastic working, wherein said plastically worked product has a hcp structured magnesium phase and a long period stacking ordered structure phase at room temperature:

(1) $0.2 \leqq a \leqq 3.0$;

(2) $0.2 \leqq b \leqq 5.0$; and

(3) $2a-3 \leqq b$.

6. A high strength and high toughness magnesium alloy comprising a plastically worked product which is produced by preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3), and subjecting said magnesium alloy casting product to a plastic working and a heat treatment, wherein said plastically worked product has a hcp structured magnesium phase and a long period stacking ordered structure phase at room temperature:

(1) $0.2 \leqq a \leqq 5.0$;

(2) $0.2 \leqq b \leqq 5.0$; and

(3) $0.5a-0.5 \leqq b$.

7. A high strength and high toughness magnesium alloy comprising a plastically worked product which is produced by preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to

(3), and subjecting said magnesium alloy casting product to a plastic working and a heat treatment, wherein said plastically worked product has a hcp structured magnesium phase and a long period stacking ordered structure phase at room temperature:

(1) $0.2 \leqq a \leqq 3.0$;

(2) $0.2 \leqq b \leqq 5.0$; and

(3) $2a-3 \leqq b$.

8. A high strength and high toughness magnesium alloy according to any one of claims 4 to 7, wherein said long period stacking ordered structure phase has at least single-digit smaller dislocation density than said hcp structured magnesium phase.

9. A high strength and high toughness magnesium alloy according to any one of claims 4 to 8, wherein said long period stacking ordered structure phase has a crystal grain having a volume fraction of 5% or more.

10. A high strength and high toughness magnesium alloy according to any one of claims 4 to 9, wherein said plastically worked product has at least one kind of precipitation selected from the group consisting of a compound of Mg and rare-earth element, a compound of Mg and Zn, a compound of Zn and rare-earth element and a compound of Mg, Zn and rare-earth element.

11. A high strength and high toughness magnesium alloy according to claim 10, wherein said at least one kind of precipitation has a total volume fraction of larger than 0 to 40% or less.

12. A high strength and high toughness magnesium alloy according to any one of claims 4 to 11, wherein said plastic working is carried out by at least one process in a rolling, an extrusion, an ECAE working, a drawing, a forging, a press, a form rolling, a bending, a FSW working and a cyclic working of theses workings.

13. A high strength and high toughness magnesium alloy according to any one of claims 4 to 12, wherein a total strain amount when said plastic working is carried out is 15 or less.

14. A high strength and high toughness magnesium alloy according to any one of claims 4 to 12, wherein a total strain amount when the plastic working is carried out is 10 or less.

15. A high strength and high toughness magnesium alloy according to any one of claims 1 to 14, wherein Mg contains y atomic% of at a total amount of Y and/or Gd, wherein "y" satisfies the following expressions (4) and

(5),

(4) $0 \leqq y \leqq 4.8$ and

(5) $0.2 \leqq b+y \leqq 5.0$.

16. A high strength and high toughness magnesium alloy according to any one of claims 1 to 15, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of Yb, Tb, Sm and Nd, wherein "c" satisfies the following expressions (4) and (5):

(4) $0 \leqq c \leqq 3.0$; and,

(5) $0.2 \leqq b+c \leqq 6.0$.

17. A high strength and high toughness magnesium alloy according to any one of claims 1 to 15, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of La, Ce, Pr, Eu and Mm, wherein "c" satisfy the following expressions (4) and (5):

(4) $0 \leqq c \leqq 3.0$; and

(5) $0.2 \leqq b+c \leqq 6.0$.

18. A high strength and high toughness magnesium alloy according to any one of claims 1 to 15, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of Yb, Tb, Sm and Nd and "d" atomic%, in a total amount, of at least

one element selected from the group consisting of La, Ce, Pr, Eu and Mm, wherein "c" and "d" satisfies the following expressions (4) to (6):

(4) $0 \leqq c \leqq 3.0$;

(5) $0 \leqq d \leqq 3.0$; and

(6) $0.2 \leqq b+c+d \leqq 6.0$.

19. A high strength and high toughness magnesium alloy comprising "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3):

(1) $0.1 \leqq a \leqq 5.0$;

(2) $0.5 \leqq b \leqq 5.0$; and

(3) $0.5a-0.5 \leqq b$.

20. A high strength and high toughness magnesium alloy comprising "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3):

(1) $0.1 \leqq a \leqq 3.0$;

(2) $0.1 \leqq b \leqq 5.0$; and

(3) $2a-3 \leqq b$.

21. A high strength and high toughness magnesium alloy according to claim 19 or claim 20 comprising a magnesium alloy casting product to which a plastic working after cutting is subjected.

22. A high strength and high toughness magnesium alloy comprising a plastically worked product which is produced by preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3), cutting said magnesium alloy casting product to form a chip-shaped casting product and then solidifying said chip-shaped casting product by a plastic working, wherein said plastically worked product has a hcp structured magnesium phase and a long period stacking ordered structure phase at room temperature:

(1) $0.1 \leqq a \leqq 5.0$:

(2) $0.1 \leqq b \leqq 5.0$: and

(3) $0.5a-0.5 \leqq b$.

23. A high strength and high toughness magnesium alloy comprising a plastically worked product which is produced by preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group

consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3), cutting said magnesium alloy casting product to form a chip-shaped casting product and then solidifying said chip-shaped casting product by a plastic working, wherein said plastically worked product has a hcp structured magnesium phase and a long period stacking ordered structure phase at room temperature:

(1) $0.1 \leqq a \leqq 3.0$;

(2) $0.1 \leqq b \leqq 5.0$; and

(3) $2a-3 \leqq b$.

24. A high strength and high toughness magnesium alloy comprising a plastically worked product which is produced by preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3), cutting said magnesium alloy casting product to form a chip-shaped casting product and then solidifying said chip-shaped casting product by a plastic working and a heat treatment, wherein said plastically worked product has a hcp structured magnesium phase and a long period stacking ordered structure phase at room temperature:

(1) $0.1 \leqq a \leqq 5.0$;

(2) $0.1 \leqq b \leqq 5.0$; and

(3) $0.5a-0.5 \leqq b$.

25. A high strength and high toughness magnesium alloy comprising a plastically worked product which is produced by preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3), cutting said magnesium alloy casting product to form a chip-shaped casting product and then solidifying said chip-shaped casting product by a plastic working and a heat treatment, wherein said plastically worked product has a hcp structured magnesium phase and a long period stacking ordered structure phase at room temperature:

(1) $0.1 \leqq a \leqq 3.0$;

(2) $0.1 \leqq b \leqq 5.0$; and

(3) $2a-3 \leqq b$.

26. A high strength and high toughness magnesium alloy according to any one of claims 22 to 25, wherein said hcp structured magnesium phase has an average particle size of 0.1μm or more.

(1) 27. A high strength and high toughness magnesium alloy

according to any one of claims 22 to 26, wherein said long period stacking ordered structure phase has at least single-digit smaller dislocation density than said hcp structured magnesium phase

28. A high strength and high toughness magnesium alloy according to any one of claims 22 to 27, wherein said long period stacking ordered structure phase has a crystal grain having a volume fraction of 5% or more.

29. A high strength and high toughness magnesium alloy according to any one of claims 22 to 28, wherein said plastically worked product contains at least one kind of precipitation selected from the group consisting of a compound of Mg and rare-earth element, a compound of Mg and Zn, a compound of Zn and rare-earth element and a compound of Mg, Zn and rare-earth element.

30. A high strength and high toughness magnesium alloy according to claim 29, wherein said at least one kind of precipitation has a total volume fraction of larger than 0 to 40% or less.

31. A high strength and high toughness magnesium alloy according to any one of claims 22 to 30, wherein said plastic working is carried out by at least one process in a rolling, an extrusion, an ECAE working, a drawing,

a forging, a press, a form rolling, a bending, a FSW working and a cyclic working of theses workings.

32. A high strength and high toughness magnesium alloy according to any one of claims 22 to 31, wherein a total strain amount when said plastic working is carried out is 15 or less.

33. A high strength and high toughness magnesium alloy according to any one of claims 22 to 31, wherein a total strain amount when said plastic working is carried out is 10 or less.

34. A high strength and high toughness magnesium alloy according to any one of claims 19 to 33, wherein Mg contains "y" atomic%, in a total amount, of Y and/or Gd, wherein "y" satisfies the following expressions (4) and (5):

(4) $0 \leqq y \leqq 4.9$; and

(5) $0.1 \leqq b+y \leqq 5.0$.

35. A high strength and high toughness magnesium alloy according to any one of claims 19 to 34, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of Yb, Tb, Sm and Nd, wherein "c" satisfies the following expressions (4) and (5):

(4) $0 \leqq c \leqq 3.0$; and

(5) $0.1 \leqq b+c \leqq 6.0$.

36. A high strength and high toughness magnesium alloy according to any one of claims 19 to 34, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of La, Ce, Pr, Eu and Mm, wherein "c" satisfies the following expressions (4) and (5):

(4) $0 \leqq c \leqq 3.0$; and

(5) $0.1 \leqq b+c \leqq 6.0$.

37. A high strength and high toughness magnesium alloy according to any one of claims 19 to 34, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of Yb, Tb, Sm and Nd and "d" atomic%, in a total amount, of at least one element selected from the group consisting of La, Ce, Pr, Eu and Mm, wherein "c" and "d" satisfy the following expressions (4) to (6):

(4) $0 \leqq c \leqq 3.0$;

(5) $0 \leqq d \leqq 3.0$; and

(6) $0.1 \leqq b+c+d \leqq 6.0$.

38. A high strength and high toughness magnesium alloy according to any one of claims 1 to 37, wherein Mg contains larger than 0 atomic% to 2.5 atomic% or less,

in a total amount, of at least one element selected from the group consisting of Al, Th, Ca, Si, Mn, Zr, Ti, Hf, Nb, Ag, Sr, Sc, B, C, Sn, Au, Ba, Ge, Bi, Ga, In, Ir, Li, Pd, Sb and V.

39. A method of producing a high strength and high toughness magnesium alloy comprising;

a step for preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3), and

a step for producing a plastically worked product by subjecting said magnesium alloy casting product to a plastic working:

(1) $0.2 \leqq a \leqq 5.0$;

(2) $0.2 \leqq b \leqq 5.0$; and

(3) $0.5a-0.5 \leqq b$.

40. A method of producing a high strength and high toughness magnesium alloy comprising;

a step for preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions

(1) to (3), and

a step for producing a plastically worked product by subjecting said magnesium alloy casting product to a plastic working:

(1) $0.2 \leqq a \leqq 3.0$;

(2) $0.5 \leqq b \leqq 5.0$; and

(3) $2a-3 \leqq b$.

41. A method of producing a high strength and high toughness magnesium alloy according to claim 39 or claim 40, wherein said magnesium alloy casting product has a hcp structured magnesium phase and a long period stacking ordered structure phase.

42. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 30 to 41, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of Yb, Tb, Sm and Nd, wherein "c" satisfies the following expressions (4) and (5):

(4) $0 \leqq c \leqq 3.0$; and

(5) $0.2 \leqq b+c \leqq 6.0$.

43. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 40 to 42, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group

consisting of La, Ce, Pr, Eu, Mm and Gd, wherein "c" satisfies the following expressions (4) and (5):

(4) $0 \leqq c \leqq 3.0$; and

(5) $0.2 \leqq b+c \leqq 6.0$.

44. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 39 to 41, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of Yb, Tb, Sm and Nd and "d" atomic%, in a total amount, of at least one element selected from the group consisting of La, Ce, Pr, Eu, Mm and Gd, wherein "c" and "d" satisfy the following expressions (4) to (6):

(4) $0 \leqq c \leqq 3.0$;

(5) $0 \leqq d \leqq 3.0$; and

(6) $0.2 \leqq b+c+d \leqq 6.0$.

45. A method of producing a high strength and high toughness magnesium alloy comprising:

a step for preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3);

a step for producing a chip-shaped casting product

by cutting said magnesium alloy casting product; and

a step for producing a plastically worked product by solidifying said chip-shaped casting product by a plastic working:

(1) $0.1 \leqq a \leqq 5.0$;

(2) $0.1 \leqq b \leqq 5.0$; and

(3) $0.5a-0.5 \leqq b$.

46. A method of producing a high strength and high toughness magnesium alloy comprising:

a step for preparing a magnesium alloy casting product containing "a" atomic% of Zn, "b" atomic%, in a total amount, of at least one element selected from the group consisting of Dy, Ho and Er and a residue of Mg, wherein "a" and "b" satisfy the following expressions (1) to (3);

a step for producing a chip-shaped casting product by cutting said magnesium alloy casting product; and

a step for producing a plastically worked product by solidifying said chip-shaped casting product by a plastic working:

(1) $0.1 \leqq a \leqq 3.0$;

(2) $0.1 \leqq b \leqq 5.0$; and

(3) $2a-3 \leqq b$.

47. A method of producing a high strength and high toughness magnesium alloy according to claim 46 or claim

47, wherein said magnesium alloy casting product has a hcp structured magnesium phase and a long period stacking ordered structure phase.

48. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 45 to 47, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of Yb, Tb, Sm and Nd, wherein "c" satisfies the following expressions (4) and (5):

(4) $0 \leqq c \leqq 3.0$; and

(5) $0.1 \leqq b+c \leqq 6.0$.

49. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 45 to 47, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of La, Ce, Pr, Eu, Mm and Gd, wherein "c" satisfies the following expressions (4) and (5):

(4) $0 \leqq c \leqq 3.0$; and

(5) $0.1 \leqq b+c \leqq 6.0$.

50. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 45 to 47, wherein Mg contains "c" atomic%, in a total amount, of at least one element selected from the group consisting of Yb, Tb, Sm and Nd and "d" atomic%, in a

total amount, of at least one element selected from the group consisting of La, Ce, Pr, Eu, Mm and Gd, wherein "c" and "d" satisfy the following expressions (4) to (6):

(4) $0 \leqq c \leqq 3.0$;

(5) $0 \leqq d \leqq 3.0$; and

(6) $0.1 \leqq b+c+d \leqq 6.0$.

51. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 39 to 50, wherein Mg contains larger than 0 atomic% to 2.5 atomic% or less, in a total amount, of at least one element selected from the group consisting of Al, Th, Ca, Si, Mn, Zr, Ti, Hf, Nb, Ag, Sr, Sc, B, C, Sn, Au, Ba, Ge, Bi, Ga, In, Ir, Li, Pd, Sb and V.

52. A method of producing a the high strength and high toughness magnesium alloy according to any one of claims 39 to 51, wherein said plastic working is carried out by at least one process in a rolling, an extrusion, an ECAE working, a drawing, a forging, a press, a form rolling, a bending, a FSW working and a cyclic working of theses workings.

53. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 39 to 52, wherein a total strain amount when said

plastic working is carried out is 15 or less.

54. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 39 to 52, wherein a total strain amount when said plastic working is carried out is 10 or less.

55. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 39 to 54 comprising a step for heat-treating said plastically worked product after said step for producing said plastically worked product.

56. A method of producing a high strength and high toughness magnesium alloy according to claim 55, wherein said heat treatment is carried out under a condition of a temperature of 200°C to less than 500°C and a treating period of 10 minutes to less than 24 hours.

57. A method of producing a high strength and high toughness magnesium alloy according to any one of claims 39 to 56, wherein said magnesium alloy after subjecting to said plastic working has said hcp structured magnesium phase having single-digit larger dislocation density than a long period stacking ordered structure phase.